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25 January 1965

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MEMORANDUM FOR: Assistant Director, OSA

SUBJECT: OXCART Suppliers' Meeting of 15 January 1965

25X1 1. On 15 January 1965 an OXCART suppliers' meeting was held [redacted] In attendance were General Carter,
25X1 H. Knoche, [redacted] representatives of OSA, LAC, P&W,
25X1 [redacted]

2. Copies of the charts which were presented by LAC at the meeting are available in the D/TECH office. Although these charts are essentially self-explanatory, certain significant remarks and conclusions are noted below:

a. One range degradation factor which is ever present results from very small deviations from the intended flight path. For a deviation of 1^{o} off course, an acceleration of 1.05 g's for 8 seconds is required to return to the course. This is equivalent to a weight increase of approximately 5000 lbs. In addition the drag is increased while pulling the g's.

b. Wind tunnel tests have indicated that holding the tertiary doors on the ejector open from Mach .9 - 1.15 may add up to 1500 lbs. additional excess thrust. Flight tests must be conducted as soon as possible with the doors locked open and then free floating to verify this potential increase.

c. Latest wind tunnel tests have verified that the present duct configuration is optimized and no modifications are deemed necessary.

d. There appears to be a potential gain of "several thousand pounds of thrust" between Mach 2.2 - 2.6 by rescheduling the variation of the forward bypass with spike position and Mach number.

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3. Aircraft 121 will remain in flying status with the Hamilton-Standard inlet control and automatic forward bypass doors for six more flights to permit assessment of the HSD inlet control "J" cam with automatic forward bypass (Phase II inlet). Subsequently aircraft 121 will have Lockheed inlet controls installed and remain as a primary engineering flight test vehicle along with aircraft 122 which will retain HSD inlet controls.

4. Headquarters must render a decision regarding the proposed modification program submitted by LAC. Pending any decision, however, the modification to permit a 450 KEAS climb profile is underway and the fix to eliminate the LN_2 leakage is now being installed in aircraft 127. 25X1

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6. A Phase II SKYLARK modification list has been established by the DCM (See Attachment I). The 450 KEAS climb mod refers to a stronger actuator for the rudder post necessary because of the higher aerodynamic loads encountered at the increased climb speeds.

7. A review of the system reliability revealed that there has been no overall improvement in reliability during the past two months. However, it was noted that, excluding complete malfunctions, the various systems are operating extremely well in contrast to previous marginal performances which were not considered malfunctions and, as such, did not affect the statistical reliability. However, Lockheed asserted that they were putting forth an all-out effort to double the current reliability figures.

8. With the incorporation of the Phase II inlet, the SKYLARK aircraft potentially should be capable of Mach 3.05 flight. However, the anticipated problems associated with high Mach number sustained flight must still be identified and appropriate corrective action taken. The Mach 3.05

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limit is imposed because that is the speed at which the ram recovery falls off abruptly. When the reason for this abrupt fall off is determined and the necessary corrective action taken, the SKYLARK aircraft potentially should be capable of Mach 3.2 flight after the sustained high Mach number problems have been rectified. In addition, the following engine limitations should be remembered. Until further Mach 3 flight experience is acquired with the engine, hot section inspections are required after every five hours at Mach 3, time between overhauls is limited to ten hours at Mach 3 and other inspections are required for specific problem areas such as first stage compressor blades after every 6 flights above 500°F inlet temperature (M2.8) and compressor second stage disc inspections after every ten cycles to Mach 3.

9. A complete set of all charts presented by P&W are also available in the D/TECH office. Ten of the more significant engine areas of interest include the following:

a. Second compressor stage disc growth.

The improved design of this disc is now installed in 21 engines. Also since experience to date indicates that flight conditions are more severe than ground testing experience, ground development tests in Florida are now being conducted to verify the design life of other stages and revised designs and cooling schemes for other discs are being scheduled for test.

b. Afterburner nozzle actuator closing line failures.

Hardware of the revised design are being shipped to the Area. Other solutions, under investigation in Florida, to this problem were also discussed.

c. Current time periods between Hot Section Inspection and overhauls were discussed. Steps being taken in the development program to extend these time periods, mainly through improved turbine first stage nozzle vanes, was discussed.

d. The problems encountered with reduction gearbox oil supply and return lines and the apparently successful solutions to this problem were discussed.

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f. A status report on the inflight trimming system development and the advantages of a more simple error gauge system were discussed.

g. A status report on the first compressor stage blade root cracking problem was given. Root cracks have been found on two engines [redacted] The planned development "fix" for this problem is the new bill of material part which involves a nickel plated stainless steel shim .020" thick which is essentially wrapped around the blade before insertion in the disc. A development back up for this "fix" is the waspalloy first stage blade with its associated heavier disc. P&W has proposed a flight service test of the waspalloy blades.

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h. A complete status report on all types of engine ignition systems was given. This included the recently developed fuel purged TEB probe of which 60 sets of hardware have been delivered to date. Experience with this system to date in flight and experimental engines has not resulted in any probe plugging. The status of the Hydrogen ignition system development was discussed. Sixteen sets of this type of hardware have been delivered but it is the opinion of the engine contractor that sufficient experience with this system has not been accumulated to date to merit consideration of a retrofit to this system at this time. The main doubt here involves the electrical glow plug ignition system and its reliability, especially until the "Y" engines can be fitted with the dual electrical igniter system at overhaul. There is also some question as to how long the "glow plugs" could be sustained by the aircraft battery after failure of the aircraft electrical system. A revision of the current TEB

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system has been studied in the development program which reduces the amount of TEB charge per shot and provides 20 instead of the current total of 12 shots. One set of this revised hardware has been delivered
25X1 [redacted] for evaluation.

i. A thorough test investigation of engine 303 at Florida to determine causes of its recent ground take-off surge problem has revealed that the following chain of events apparently occur. As a result of relatively fast aircraft descent conditions from high Mach number and the resulting rapid cooling and contraction of the engine outer case onto the rotating compressor blades, the honeycomb material which forms the tip seal for the compressor blade becomes worn excessively. Once the compressor rotor and hub finally cool and contract the compressor blades "retract" away from the honeycomb leaving an excessively large tip clearance. The surge margin of any compressor will decrease with increasing tip clearance. This engine has less surge margin at sea level static conditions than at any other flight condition and the surge margin here is also reduced by the colder outside air temperatures associated with the winter season. Since surge margin is a function of the distance between the surge line and engine operating line on a compressor map, one solution is to restore surge margin by lowering the engine operating line by reducing engine operating maximum pressure through an enlarged turbine nozzle vane area. This represents an interim method of living with the problem instead of solving it however. The wear and rub through of the honeycomb probably can be reduced by using the segmented type honeycomb installation, as is now used in the first stage, in other stages. This is under ground test development in Florida.

This problem is indicative of the sort of problems which develop as a result of increasing and repetitive high Mach number flight and are apparently affected by aircraft installation effects which differ from previous ground test environment. It is also a

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situation which bears close monitoring in the development program to assure proper assessment of the problem by the engine contractor and to assure that proper concurrent solutions to the problem are developed and then carried through to final hardware expeditiously in order to minimize flight program delay.

j. A thorough and detailed review of the all significant overhaul and field problems was also presented. A complete list of these problems is also given in the aforementioned charts.

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Attachment

25X1 ASD/OSA/[redacted](25 Jan 65)
Dist:
1 - AD/OSA
2 - DD/S&T
3 - D/TECH
4 - ASD/OSA
5 - PS/OSA
6 - D/FA/OSA
7 - OXC/OSA
8 - MD/OSA
9 - COMMO/OSA
10 - Chrono
11 - RB/OSA

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ATTACHMENT 1
TO OXC-8006-65

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PHASE II SKYLARK MODIFICATIONS

	125	127	128	132	130
Phase II Inlet System	X			X	
A/R Panels					
Black Paint			X		
LN_2 Mod					
450 KEAS Climb Mod					
Film Destruct		X			
Map Destruct					

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